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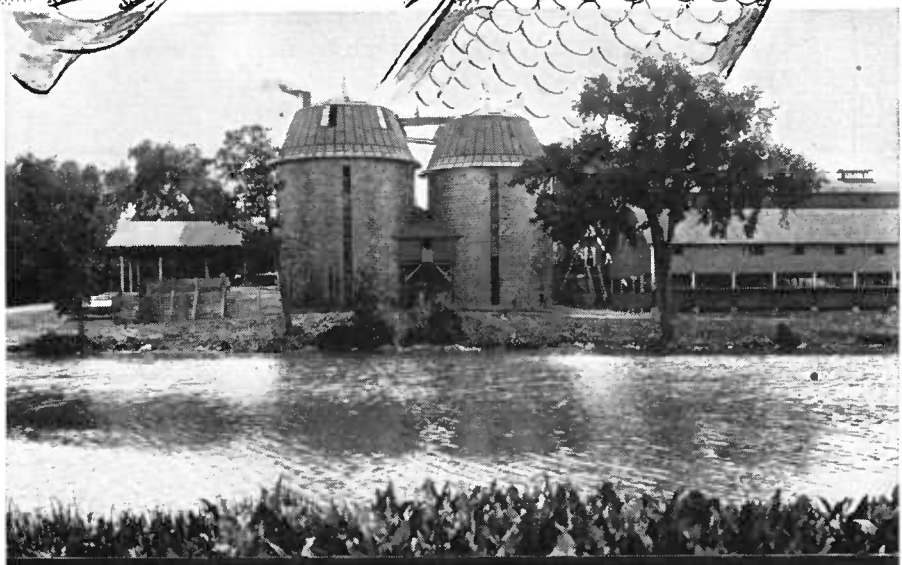
GROWING SWEET CORN for the Cannery



FARMERS' BULLETIN NO. 1634
U. S. DEPARTMENT OF AGRICULTURE

SWEET CORN, which ranks among the three most important canned vegetable commodities, is produced commercially in several of the Northern States. It is a tender annual plant easily injured by frost and will not withstand excessive heat. Its production is therefore limited to those regions where there is a minimum frost-free season of 85 to 120 days.

The successful production and canning of sweet corn on a commercial scale requires favorable soil, climatic, and economic conditions and close cooperation between the producers and the manufacturers.

Husks and other wastes from sweet corn canning are of considerable value for feeding. The stover, with the small ears remaining on it after the harvest of the canning crop, adds materially to the grower's income from the crop.

Washington, D. C.

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GROWING SWEET CORN FOR THE CANNERY

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SWEET CORN, which ranks among the three most important canned vegetable commodities, is produced in commercial quantities in several States in the northern half of the United States. In the past, acreage and production of this crop varied considerably. During the 10-year period 1935–44 acreage fluctuated from 248,260 in 1939 to 533,542 in 1943 and production from 14,566,914 cases [1] in 1939 to 32,118,382 cases [1] in 1943. Part of the increase in production for the war period is undoubtedly due to the demand by the armed forces (approximately 7,500,000 cases [1] in 1944). This demand may drop off, but the general adoption of yellow varieties, particularly yellow hybrids, has stimulated a higher consumer demand for canned sweet corn and will undoubtedly continue to do so. Approximately 70 percent of the acreage in 1944 consisted of the yellow varieties. Because of the emphasis on high-quality varieties and packs, the demand should not drop too much after the war.

CLIMATIC REQUIREMENTS

Climatic and soil conditions have influenced to a large degree the growth of the sweet corn canning industry. Sweet corn is a tender annual plant easily injured by frost and excessive heat. This fact limits its production to those regions where there is a minimum frost-free season of from 85 to 120 days within which suitable varieties may

[1] 24 No. 2 cans to each case.

be grown. The spring months should be sufficiently warm so that the corn will make a rapid and uninterrupted growth; but excessively hot weather during the summer months, especially when accompanied by drought, may cause premature ripening and low yields. Cool summer weather has a tendency to retard the ripening of the kernels, extending the period through which the ears are in edible condition. An average annual rainfall of about 40 inches, properly distributed throughout the year, will supply enough water for bringing the crop to the proper stage of maturity for canning.

ECONOMIC CONSIDERATIONS

The canning of corn economically and in conformity with modern standards of quality requires expert supervision and a large investment in factory equipment. If a corn canner is to operate his business successfully, he must be able to obtain an adequate supply of high-quality corn at prices that will leave him a reasonable margin of profit after he has disposed of his pack on markets in which competition is keen and prices are often unstable.

These conditions prevent the successful operation of a corn-canning establishment in a section where good yields and an adequate acreage on lands of medium value cannot be obtained. The sections preferred are those where the growing of two or more canning crops whose harvest dates do not conflict makes possible a longer operating season for the cannery. There is also a strong tendency to locate a canning industry in dairy or cattle-growing sections where the stalks and husks from the cannery can be used for feed.

Sweet corn may be successfully produced in growing seasons too short for the maturing of most varieties of field corn. It fits well into the farm-crop rotation and occupies the land a shorter time than certain other crops, giving an opportunity for an increased use of green-manure and cover crops. Since cannery corn is usually grown under contract and delivered as soon as harvested, marketing and storage problems are eliminated. The stover and cannery wastes afford a supply of succulent roughage for livestock at a period when other sources of such feed are often scarce.

METHODS FOLLOWED BY CANNERS TO PROVIDE FOR SUPPLIES OF SWEET CORN

In the Eastern States most of the sweet corn crop is raised by numerous growers in small fields of a few acres each, whereas in the Corn Belt there are factories each of which operates several thousand acres devoted mainly to sweet corn. Probably three-fourths of the green corn packed is grown under contract by individual growers. The seed is often furnished to the grower by the canner generally at the wholesale price or less, but it may be obtained direct from the seed companies. The seed is often graded and dusted for disease control by the canning company which supplies it. In many cases the grower is supplied with the proper-sized planting plates for the grade of seed furnished. The grower usually agrees to separate the different varieties of sweet corn from one another or from field corn by a stated distance, to plant carefully, to cultivate thoroughly, and to keep the fields free from weeds until the crop is ready to harvest. The crop

must be harvested in the milk stage. The ears are snapped or cut off with the minimum amount of shank and are delivered to the factory on the same day they are harvested, before the corn has become heated or otherwise damaged. Contracts are made some months before planting time, sometimes on a sliding scale, but oftener at a stipulated price per ton for a given variety. The tonnage may be based on corn in the husk or on husked corn. The variety and the acreage are specified for each grower, sometimes with a clause relative to separate planting at stated intervals.

SOIL AND FERTILITY REQUIREMENTS

SOILS

Sweet corn is produced on soils similar to those used for field corn, but the crop is more exacting as to the conditions under which it is most successfully grown. Sandy soils should be avoided. A well-drained, medium-heavy loam abundantly supplied with organic matter will probably give the best results. Where heavy clays are used, their physical character should be improved by turning under large quantities of manure and cover crops. Moderately heavy soils are preferred, since they are more retentive of moisture and the crop is less likely to suffer from drought during the latter part of the growing season. These soils cannot be worked as early as the lighter soils, but that is no particular disadvantage because earliness usually is not a very important factor with the canning crop.

CROP ROTATION

Crop rotation is considered essential to continued success in modern farming. It is one of the requisites for improving worn-out soils and for maintaining soil fertility. It tends to prevent the exhaustion of any one particular element of plant food and is an aid in holding in check certain insects, diseases, and weeds.

It is impossible to suggest rotations suitable to all sections, but one that brings sweet corn on the same ground not more than once every 4 years is most desirable. Such a rotation should include a sod crop, preferably clover or clover and timothy. This combination can occupy the land for 2 years and then should be followed by sweet corn. Some cover crop, such as crimson clover, may be sown at the time the corn is given its last cultivation, or rye or barley may be seeded after the corn is harvested. These are turned under the following spring before such plantings as peas or oats. A green-manure crop, such as cowpeas or soybeans, may be sown at the last cultivation of the sweet corn and turned under after harvest but before frost. In other cases a grain such as winter wheat, either alone or with grass, may be seeded in the corn stubble. When two grain crops, such as oats followed by wheat, appear in the rotation, grass seed is combined with the latter for the subsequent hay and pasturage. The rotation must be planned to suit the locality, the soil, and the general type of farming.

In many sections, particularly in Illinois and other portions of the sweet corn areas, no definite rotation is followed but care is taken to have the crop follow some legume such as alfalfa or sweetclover. Even on naturally fertile soils it is advisable to follow established principles of crop rotation.

GREEN MANURE

Rotations should include rapidly growing, short-season crops of either leguminous or nonleguminous plants that are plowed under for green manure. The legumes are an advantage in that, when the proper nitrogen-fixing bacteria are present in the soil, nitrogen is removed from the air under favorable conditions and is made available for plant growth. The application of succulent plant material to the soil adds organic matter, improving both the physical and the chemical character of the soil and promoting the growth of helpful soil bacteria. These crops are also an aid in suppressing weed growth. Whenever practicable, the land should be protected from erosion over winter by a cover crop that may be turned under in the spring. Winter cover crops, such as rye, should be turned under before they have become tall and strawy, as material of this character, if plowed under immediately before planting, is likely to rob the crop of nitrogen.

STABLE MANURE

Heavy yields of sweet corn of high quality are obtained only when the soil contains an abundance of readily available plant food. This can be obtained in part from stable manure, which is one of the most valuable of all fertilizing materials. Not only does barnyard manure contain most of the food elements required by plants, but it also has a markedly beneficial effect upon the physical condition of the soil. The plant-food value of manure depends upon the source and upon the conditions under which it has been kept. Manure that has been exposed to weathering and to other unfavorable conditions may have lost the greater portion of its fertility and may be of value only for the organic matter contained. Unleached manure, therefore, is preferable because of its additional plant food.

On soils suitable for the growing of sweet corn, dressings of from 10 to 12 tons of good-quality stable manure per acre should give good results. As a rule it is most economically applied with a manure spreader. Unless the manure can be stored so that it will not deteriorate, it is better to distribute it as produced. The greatest value will doubtless be obtained by spreading rotted manure on plowed land, to be worked in by disking at the time the soil is prepared for plainting. Large quantities of coarse, strawy manure should not be applied immediately before a crop is planted, but preferably manure should be turned under the previous fall.

FERTILIZERS

Commercial fertilizers alone are insufficient to give good crops of sweet corn. Such fertilizers should supplement rather than supplant animal and green manures. The kind and quantity to be used depend on the needs of the soil and the quantity of stable manure previously applied. A sufficient quantity should be used to maintain high production, and such applications should be made before the crops show a marked reduction in yield. Each grower must determine the particular kind and the quantity of fertilizer required for the best results under his own soil conditions. In general, a fertilizer containing from 4 to 5 percent nitrogen, 8 to 10 percent phosphoric acid, and 5 to 6 percent potash will be found satisfactory. The rate of application will vary from 200 to 600 pounds per acre, the lower

quantity being used when barnyard manure has been applied. Superphosphate (16 percent phosphoric acid) applied with manure at the rate of 50 pounds per ton of manure has given good results.

Some growers have obtained superior results by applying the phosphoric acid and the potash-carrying materials at the time the soil is prepared for planting, and then applying the nitrogenous material as a side dressing later, at the time of the first cultivation. Although this practice seems to be very desirable from the standpoint of obtaining the best growth and highest yield, some extra equipment is needed and it involves the additional labor of going over the field to apply the material. Although attachments are available for a number of standard makes of cultivators for applying top dressing during cultivation, the individual grower must determine whether the additional labor and expense will yield sufficient gains to make this practice profitable.

Commercial fertilizers may be applied near the row, with a combination planter and fertilizer distributor, at the rate of 100 to 200 pounds per acre at planting time, but they should not come in contact with the seed. If more than 200 pounds per acre is to be applied, the excess should be broadcast and worked in during the final fitting of the soil before planting.

LIME

Sweet corn is not particularly sensitive to soil acidity, but lime may be essential to some of the other crops in the rotation. Lime frequently improves the physical texture of soils, especially those of a clay nature, and it also tends to liberate through its chemical action some of the plant nutrients of the soil. If the lime requirement is satisfactory for the legumes and other crops in the rotation, soil acidity will not be a limiting factor in growing sweet corn.

PREPARATION OF THE LAND

Thorough preparation of the seedbed is a very important factor in obtaining high yields of sweet corn. It influences to a large extent the cost of cultivation; growth, through its effect upon the penetration of the corn roots; and the retention and supply of soil moisture.

There is a great diversity of opinion as to the methods to be followed in the preparation of the soil, owing for the most part to the varied needs of soils, which differ widely in their physical nature. Fall plowing of all stiff and sod land, leaving the fitting until spring, affords a better seasonal distribution of farm labor. The exposure of such plowed land during winter improves the physical condition of the soil, assists in the decay of vegetable matter, and destroys the larvae of many insects. Fall plowing may be advisable where winter washing of the soil is not likely to occur, but it cannot be practiced when the land is occupied by winter cover crops. Spring plowing may be better with the lighter soils, especially when they are well drained. The depth of plowing will depend on the nature of the land and the previous cropping system. It is a good practice on many soils to increase the depth of plowing half an inch each season until a depth of 8 to 10 inches has been obtained. In fitting the land, the top layer should be thoroughly fined by disking and harrowing to a depth of at least 4 inches, and preferably deeper if possible. A good seedbed must be

deep, well-defined, and free from lumps or clods and weeds. A detailed discussion of the preparation of the land is given in Farmers' Bulletin 1714, Corn Culture.

TYPES AND VARIETIES FOR CANNING

Intensive work during the past several years by Federal and State research institutions, canners, canners' associations, commercial seedsmen, and others in developing, testing, increasing, and introducing hybrid sweet corn has brought about an almost complete change in the types and varieties of sweet corn used for canning. The increased use of yellow sorts to the point where they now constitute about three-fourths of the canning acreage is particularly noteworthy. A tabulation from data of the National Canners Association shows that in 1944 there were 364,156 and 131,660 areas of yellow and white varieties, respectively. The attractive appearance and high quality of the yellow-grained corn are undoubtedly responsible for a considerable portion of the increased demand for these sorts. There is much justification for the belief that the increase in acreage and production of sweet corn for canning during the war period is not entirely due to stimulated war demands and that much of the demand will continue after the war. The major part of the sweet corn grown for canning is from hybrid seed, largely of yellow kinds, but accurate data on the quantity are not available.

Hybrid sweet corn seed must be produced under rigidly controlled conditions. None but research institutions, commercial seedsmen, canning companies, crop-improvement associations, or other organizations capable of maintaining seed-maintenance departments are in a position to perform the work satisfactorily. Research institutions confine their efforts chiefly to basic work on foundation stocks, leaving commercial-scale hybrid-seed production to others. Seed from hybrid corn cannot be used profitably for a succeeding crop. For each new crop a fresh lot of true hybrid seed produced under controlled conditions must be employed. In some cases canners purchase the hybrid seed from seedsmen and supply their farmers in accordance with their needs. In other cases farmers and canners agree on the varieties to be grown and the farmers purchase direct from seedsmen. Sometimes canning companies produce the hybrid seed and supply their growers in accordance with mutually agreeable arrangements. The comparatively small acreage of sweet corn for canning which is grown from nonhybrid seed, or so-called open-pollinated varieties, is usually procured from commercial sources, but sometimes seed is saved from a previous crop. The high-yielding qualities of hybrid corn, its uniformity of ear height, which makes mechanical picking more practicable, its uniform maturity, and other features commend it to the canner and grower to such an extent that open-pollinated seed for the canning crop has been almost entirely displaced.

New hybrids are constantly being produced and introduced; hence the variety situation for canning-crop sweet corn is likely to continue to change from year to year. Only general variety recommendations can be given because some that are adapted to culture in certain sections are not well adapted elsewhere. As a general rule every grower should be guided by the requirements of the canning com-

pany for which the corn is to be grown. Information gathered from various sources, including State experiment stations, canning companies, and the National Canners Association, shows that a few hybrids constitute the bulk of the canning crop. However, there are wide differences in the adaptation of some hybrids to geographical locations and some differences of opinion among authorities about the merits of different hybrids. Because of soil, climatic, and economic factors this situation is to be expected. Existing hybrids have given the canners and growers higher quality, heavier yielding, disease- and insect-resistant stocks, which have added greatly to the value of the canning crop, but research workers, seedsmen, and canners are not fully satisfied with the hybrids now available and are constantly seeking improvement.

Because of the rapidly changing situation in regard to canning-crop sweet corn hybrids it is impossible to give an adequate discussion which would not be obsolete in a few seasons. Brief information on the more important hybrids used in 1944 is given on pages 7 to 10. Others not mentioned may be just as good or better, but they have not been adequately tested or brought into extensive use. The discussion of varieties, hybrids, and seed stocks of sweet corn for canning is of a general nature and is intended only as a guide to the trends in the industry. As stated previously, in all cases the choice of a hybrid or a variety depends on local conditions. The experience of the canner and his growers in each section must be the final guide in selecting the hybrid, strain, or variety to be grown.

YELLOW-GRAINED HYBRIDS

GOLDEN CROSS BANTAM

Golden Cross Bantam was originated in 1927 cooperatively by the United States Department of Agriculture and the Indiana Agricultural Experiment Station. It was the result of a cross between two inbred lines developed from Golden Bantam: Purdue 39, an inbred having 10 to 14 rows as the female, or seed, parent and Purdue 51, an inbred of the regular 8-row Golden Bantam, as the pollen, or male, parent. The hybrid was released for trial in 1928. After trials under varying environmental conditions for several years, it was introduced to the general trade in 1933 by a number of seedsmen.

After several years' commercial experience with this hybrid, its originator, Glenn M. Smith, wrote as follows:

> When Golden Cross Bantam was released for commercial production it was with the realization that it was not a perfect corn but would serve as a "yardstick" for comparison in the development of new hybrids. However, it has become so accepted by the industry that it will be difficult to displace it completely. Its wide adaptation and resistance to bacterial wilt have made it possible to produce yellow sweet corn in States where previously Golden Bantam could not be grown profitably. It reaches canning stage uniformly and remains in this condition over a reasonably long period.

A detailed description of the hybrid is unnecessary and probably undesirable, because there are numerous seedsmen's and canners' strains which exhibit differences. In general, however, the original strain is tall; about three-fourths of the plants are 6¼ to 7½ feet tall and the remainder are shorter. The ears are high, approximately

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two-thirds of them being 33 to 40 inches from the ground. Husked ears are moderately long, 8 to 9 inches or longer, nearly cylindrical, and slightly tapering toward the tip. About 85 percent of the ears are 12- to 14-rowed, some are 10-rowed, and others are irregular. The kernels are bright creamy yellow. From planting to canning maturity from 80 to 95 days elapse, depending on where and when the corn is planted. It is highly resistant to bacterial wilt.

Golden Cross Bantam accounts for a very large proportion of the yellow sweet corn. Its head start over other hybrids and the fact that seed production is standardized and developed on a large scale contribute to this situation; yet through merit other yellow sorts may displace it as the leader. In the Middle West about 80 percent of all the sweet corn grown for canning is of the Bantam type. This is predominantly Golden Cross Bantam or various seed companies' versions of it. Much of the pack of yellow corn consists of hybrids produced by the canning companies. Special strains of Golden Cross Bantam are widely used in Maine, Maryland, and elsewhere. There is a strong tendency to develop special strains that are better suited in individual conditions. In Maine, for instance, it was found that the original strain did not mature before frost. Although more than 15 years have elapsed since Golden Cross Bantam was first released for trial, it is still used as the standard of comparison in judging new hybrids. It is widely grown for all purposes; it is canned as whole kernels, cream style, and corn on the cob and is frozen as whole ears and cut off.

IOANA

Ioana, a single-cross hybrid, was produced at the Iowa Agricultural Experiment Station; a Bantam Evergreen inbred called Iowa Inbred 45 and a strain of Purdue 39 were used as parents. The cross was made in 1934 and first produced commercially in 1938. It is a high yielder and seems to be fairly resistant to drought. Undesirable features are its tendencies to change quickly from immaturity to overmaturity and to become discolored in the can.

The plants are tall and vigorous, averaging 7 feet in height. The cylindrical ears are relatively high, about 32 inches from the ground. The rows of kernels vary from 12 to 16, with 14 rows predominating. The kernels are light yellow. Tests indicate that it is a little longer in maturing than Golden Cross Bantam. Ioana is somewhat resistant to smut, bacterial wilt, and the corn borer; it is fairly free from corn earworm in the sections where generally grown.

ILLINOIS GOLDEN HYBRID NO. 10

Illinois Golden Hybrid No. 10 has been in extensive use as a canning crop for only a season or two and is looked on as a high-quality sort. An undesirable characteristic is a decided tendency for the husks to be held between the rows of kernels, making husking expensive. This hybrid is of considerable interest, however, to canners who employ mechanical pickers, because the ears are borne high on the stalks, thereby greatly expediting the picking operation. It is recommended for the Middle West, but not for the northerly producing areas.

PURGOLD

Purgold was originated in 1934 by the United States Department of Agriculture and the Indiana Agricultural Experiment Station. It resulted from crossing Purdue 39, the female parent, with Purdue 14, the male parent. The plants are tall and vigorous; the ears are 8 to 9 inches long. This variety is a little later than Golden Cross Bantam. It is canned as whole grains and on the cob. It is also frozen. Because of its similarity to Golden Cross Bantam, it is used to extend the harvest spread of corn of this hybrid.

MINHYBRIDS

The Minhybrid group, consisting mainly of inbred lines developed from Golden Bantam, was developed by the Minnesota Agricultural Experiment Station. None of these are extensively used at the present time for canning purposes, but they appear suited to the more northerly corn-canning areas. They are of the 8-rowed type and suffer from the standpoint of yield by comparison with 12- to 16-rowed strains. They are of interest chiefly for their high quality.

KINGSCROST E–5

Kingscrost E–5, introduced in 1936, is a cross between two golden inbreds derived from Golden Bantam. The plants are of medium size and about 6 feet tall. The ears are 6 to 7 inches long and 10- to 14-rowed. The kernel color is variable, ranging from light yellow to orange. This hybrid and a companion, Kingscrost J–9, are used for whole-ear packs.

OTHER YELLOW HYBRIDS

Two of the largest sweet corn canning companies, which pack about 12 percent of the annual production, have developed their own yellow hybrids and produce their own seed. Many other yellow hybrids have also been developed. Some are used to a varying extent for canning, but the bulk of the canned product is from Golden Cross Bantam, Ioana, and Illinois Golden Hybrid No. 10. Even better sorts may be introduced and be in use soon after this bulletin is printed.

WHITE-GRAINED HYBRIDS

Practically the entire supply of white-grained hybrids grown for canning belong to the Country Gentleman or the Evergreen group. At present the bulk of the white-grained hybrid sweet corn belongs to the Country Gentleman group. Three are described here. Others are being developed by several agencies and should be ready for distribution in the near future. One narrow-grained Evergreen hybrid is described. Other hybrids of the same type in use are Illinois 14 × 11, Illinois 55 × 11, and Illinois 11 × 13. A few Stowell Evergreen hybrids are offered by seed companies that cater to the canning trade.

ILLINOIS 8 × 6

Illinois 8 × 6, a single-cross Country Gentleman hybrid, was originated by the Illinois Agricultural Experiment Station. The plants average 7 feet in height, and the ears are 7 to 8 inches long, with no

rowing in evidence. The kernels are narrow, deep, white, and of good quality. Although this variety is not as vigorous as some sorts, it is a high yielder of cut corn. High recovery is very desirable from the canners' viewpoint. One particularly desirable feature of this hybrid is its wide climatic adaptation.

IOGENT 12

Iogent 12, which was originated in 1933 by the Iowa Agricultural Experiment Station, is another single-cross Country Gentleman hybrid. On good soil the plants are about 8 feet tall, but the crop is about 2 weeks later than those of many other strains of Country Gentleman. The ears are large and 7½ to 8 inches long and have narrow deep kernels. It is highly resistant to smut and is a very heavy yielder, but probably it requires too long a season for northern locations.

IOGENT 27

Iogent 27, another single-cross Country Gentleman hybrid, was also originated in 1933 by the Iowa Agricultural Experiment Station. It is very vigorous, 7½ to 8 feet tall, with large ears 8 inches long, very white kernels, and slight evidence of rowing. It is 7 to 10 days later than open-pollinated Country Gentleman and a very heavy yielder. Tests have shown the canned product to be whiter than that of any other variety or hybrid with which it has been closely compared. Its season is probably too long for the more northerly locations.

ILLINOIS HYBRID 14 × 13

Illinois Hybrid 14 × 13 is the result of a cross between two narrow-grained Evergreen inbreds. Both had been inbred for 17 generations. On good soil the plants are about 8 feet tall and have extremely large cylindrical ears with 14 to 22 practically straight rows. The kernels are long and medium wide. This hybrid is a high yielder, and its quality is superior to that of open-pollinated narrow-grained Evergreen. The total volume of seed produced exceeds that of all other Evergreen hybrids combined.

OPEN-POLLINATED VARIETIES

A small but important part of the sweet corn canning crop, largely of the white varieties, is produced from open-pollinated seed. In many cases growers and seedsmen have open-pollinated strains which give satisfactory performance, and they hesitate to make a change to hybrids. Country Gentleman and Stowell Evergreen are the most important varieties grown from open-pollinated seed, but there are many special strains of local importance. Although hybrid varieties now occupy a predominant position in the sweet corn canning industry, certain open-pollinated stocks are grown and will probably continue to be grown.

PLANTING

GRADING THE SEED

Experimental and practical results have shown it to be desirable to grade sweet corn seed according to size before planting and to

plant the different grades in separate blocks in the field. The shelled seed is usually passed through a grader which separates it into two sizes, large and small. Many canners who have pea-cleaning machines adapt them to the grading of corn, and others use small seed-corn graders found on the market.

The larger kernels produce a better stand and larger, stronger plants which reach the canning stage 2 or 3 days earlier than those from small seed. Planting the two grades in separate blocks in the field gives more uniform stands, and when this method is followed the uniformity in reaching the canning stage within each block is definitely superior to results obtained with seed of mixed sizes. The same planter plates should be used for both sizes of seed even though a larger number of small kernels will be planted. The probability of a poorer stand from the small kernels makes it advisable to plant a larger number. The weight of seed planted per acre will not be materially different.

TIME OF PLANTING

The planting of sweet corn is ordinarily deferred until warm, settled weather is assured, because of the inability of the seed to germinate properly when placed too early in cold, wet soil. However, in the prairie States and in those around the Great Lakes it is a common practice on sufficiently dry soils to risk an early planting to insure a crop before the early-fall frosts. The best corn is usually the result of moderately early planting combined with good soil preparation. The exact date of planting will vary, and it is normally determined in conference with the factory operator, who seeks a long, uniform maturing of the crop in order to maintain a satisfactory canning schedule.

PLANTING SYSTEMS

Systems followed in the planting of sweet corn for a given locality are usually identical with those of field corn. Drilling the seed so that the plants will stand singly in rows rather than in hills is an accepted practice in some sections. This method of planting may be especially desirable on hillsides or on rocky, stumpy ground, following either the contour or a straight line. When a checkrow planter is used, kernels are dropped in a hill, the number per hill and the interval between hills being regulated by the dropping device of the planter. The hills are so alined that straight rows are formed at right angles to the direction of the planter rows. Since cultivation can be alternated in direction in a "checked" field, the grower can keep the entire soil surface free from weeds and in good condition with the minimum amount of hand-hoeing. This system is best adapted to nearly level fields that are comparatively free from obstructions.

PLANTING DEPTHS AND DISTANCES

The depth of seeding will be governed by the nature and moisture content of the soil. In heavy clays or soils especially retentive of moisture, a depth of 1 to 1½ inches seems suitable in most localities. In loams or sandy loams, 1½ to 2 inches is recommended, but when the soils are very light, warm, and dry or when the area is subject to drought, the depth should be increased. However, if corn

is planted too deep, the young seedling will be exhausted before the leaves can start vigorous growth above ground.

The rate of seeding will be influenced by the planting distance, by the locality, by the variety, and by the richness of the land, varying from about 10 to 15 pounds of seed per acre. More kernels can be planted per hill on strong land than on thin land, but in most important sweet corn growing sections three to four stalks per hill have given the best returns at the usual spacing. It may be advisable to drop more kernels than the actual number of stalks desired to compensate for losses from insects and other causes. Too many stalks per hill will reduce the size and the total yield of ears.

Sweet corn does not grow as tall as field corn, and it is sometimes grown closer together than the field types. The distance between rows and that between stalks and hills affect to some degree the yield per acre. Plants spaced too close together give a decreased yield of ears and an increased weight of stover, while if the planting is too sparse both will be reduced. Short-growing and early varieties may be planted 30 to 36 inches apart and the medium or large-growing varieties 36 to 42 inches. If the seed is drilled, single stalks should stand 12 to 15 inches apart in the row, and if in hills they should be from 28 to 36 inches apart. Rich soils having ample moisture at the time of the formation of the ears will also bear thicker planting. The proper planting distance is another question that must be answered differently in different localities.

Some canning concerns insist that the grower separate the plantings of white and yellow varieties of sweet corn. Since this crop is wind-pollinated, the white ears may be exposed to cross-pollination with a yellow variety if the plantings are not separated. The kernel color of a yellow pollen parent becomes evident the same season that the crossing occurs, so that if pollen from a yellow variety reaches the silks of a white variety the white ears may show some yellow kernels at harvesttime. If a yellow variety is exposed to the pollen of a white variety, no effect will be seen in the resulting ears. However, if these ears are used for seed, white-kerneled plants may appear among the yellow planting. When the corn is to be used in the factory the white varieties should be planted some distance away from and to the windward of the yellow strains, because the canner will reject all white ears showing yellow kernels. Whenever sweet corn is grown for seed the two types should be widely separated.

REPLANTING

It is a waste of land and of labor to carry a poor stand through to the harvesting period. Whether to replant or not depends upon whether there will be sufficient time after replanting for the crop to reach proper maturity before frost. As a rule, it does not pay to replant an occasional hill, because of the retarded growth and poor yield resulting from the competition of the adjacent plants. If the stand is so poor that replanting is advisable, the soil should be disked and the whole field replanted. Planting between the rows without destroying the old crop results in a weedy replanted crop and is of doubtful value.

CULTIVATION AND CARE

The advantages of early planting may be lost unless it is promptly followed by cultivation, for the growth of the crop may be seriously harmed if a hard soil crust interferes with the emergence of the seedlings or if weed growth is allowed to rob the crop of moisture and nutrients. Sweet corn does not differ greatly from field corn in its cultural requirements.

Soon after planting, before the corn is up, all weeds that have started should be destroyed by shallow harrowing or by the use of a rotary hoe or other suitable shallow tillage implement. This preliminary cultivating or weeding also breaks up a hard crust that might interfere with the young seedlings. It is a simple, rapid, effective, and inexpensive method of holding weeds in check until the corn is 5 or 6 inches high. Thorough weed control up to this time, by such a method, greatly reduces the cost and increases the efficiency of later cultivation.

Shallow cultivation, as a rule, has proved to be more satisfactory than deep cultivation. Deep culture tends to break the roots of the corn plant, thereby interrupting the absorption of water and plant food. While the plant may produce new roots, it can do so only at the expense of ear and fodder production. Deep cultivation should be used only during the early stages of the growth of the crop and after excessive rains have packed the soil. A shallow soil mulch of from 1 to 2 inches in depth should destroy all weeds without injuring the roots of the crop.

The number of cultivations necessary will depend upon local conditions. The cultivator should be used after a rain as soon as the soil is dry enough to permit stirring without injury to its texture. The soil mulch should be promptly restored to prevent the baking of the surface soil and to destroy weed seedlings before they have become firmly established. If necessary in order to control weeds, shallow tillage should be continued through the tasseling period. It is sometimes profitable to remove occasional weeds by hand-hoeing even as late as the silking time of the corn. Often the grower will sow a catch crop for late pasturage, cover crops, or winter wheat or rye, to be cultivated into the soil with the last cultivation.

A choice from among the many types of cultivators that are available should depend upon local conditions. The use and advantages of several good types of cultivators are explained in Farmers' Bulletin 1714, Corn Culture.

Removing the suckers from the base of sweet corn plants is an old practice based on the belief that their removal increases the yield and size of the ear and promotes earliness. Recent experimental work shows that plants suckered early produced no greater number of ears and no higher yield by weight than those not suckered. In fact, they produced very slightly less. Poor returns were obtained when suckering was delayed until the tassels were forming. Under normal conditions, suckering is a practice that cannot be recommended in the growing of corn for canning, because of the labor and expense involved, and because no definite increases in yield result, while definite decreases may result. For those who depend upon stover for livestock it will result in the loss of some feeding material.

HARVESTING

The date of harvesting varies with the section, the variety grown, the time of planting, and also in a single locality from season to season. The kernels should be plump and full of milk; this stage normally coincides with the time when the silks begin to turn dark brown. Some experience is needed in picking the crop, the harvester being guided by the appearance of the silks and by feeling the ears to ascertain the plumpness of the kernels. The ears are snapped in the husk, a short stalk being left at the base of the ear. Some factories require that the ears be cut with a short butt in order to decrease the weight of waste, part of which might consist of long shanks.

High quality in sweet corn is closely associated with the sugar content of the kernels. During the ripening process the sugar changes rapidly to starch, the kernels passing successively through the premilk, milk, early-dough, and dough stages. The corn should be harvested in the milk stage in order to obtain a product of the best flavor and most desirable consistency. If it is harvested too soon, the yield in tons of ear corn per acre and in cases of canned corn per ton will be low and the canned product will lack body. If harvested late, the product will be lacking in flavor, will be starchy, and will contain tough seed coats.

Sweet corn passes through the milk stage in a very short time. Temperature has been shown to be the most important controlling factor in the rate of ripening. In the most southerly corn-canning regions, or during a period of warm weather farther north, the ears may remain in prime canning condition no longer than 2 days. Under such conditions harvesting must be started promptly at the proper time and completed as rapidly as the factory can handle the corn. Farther north, where the summers are cooler, or southward when the corn is planted to be canned late in the fall, it may remain in good canning condition for as long as 5 or 6 days. Under high temperatures, when ripening is very rapid, the usual test of quality, which consists of squeezing out and examining the contents of the kernel, is a less dependable index than under cool conditions.

Bearing in mind the rapid rate at which sweet corn passes through the proper stage for canning, one can readily understand why uniformly maturing stands are important. Ungraded seed, which may give as much as 2 days' variation in time of reaching the milk stage, obviously would not yield a high-quality, uniform product if the crop were harvested all at one time. In order to obtain good quality it would be necessary to harvest the field repeatedly; repeated harvesting is expensive, and even then the product would be lacking in uniformity.

The ripening process continues in green sweet corn after it is harvested, and the quality deteriorates rapidly. High temperature hastens this condition very markedly. Piles of corn at the factory or even loads of corn on wagons soon begin to heat, and a great loss in flavor results.

Sweet corn is usually harvested in the morning so that it may be handled at the factory without delay. Harvesting late in the day often gives rise to congestion at the factory, with the result that the corn deteriorates in quality before it can be placed in the cans. Most

fields of sweet corn are harvested but once, an exception being made in years of low yields or in the case of unevenly maturing plantings, when the fields may be gone over two or three times. The nubbins and the green ears are left on the stalk.

YIELDS

The yield of sweet corn depends on the variety and the conditions under which it is grown. This latter factor includes the soil, its preparation and fertilization, the rate of seeding, and the distance of planting, the efficiency of cultivation, weather conditions, and the effects of weeds, diseases, and insect pests.

Although the yield of sweet corn grown for a canning crop in the United States during the period from 1933 to 1942 averaged 2.24 tons per acre, yields may range from ½ ton to 8 tons per acre. A yield of 4 tons is not unusual.

FACTORY WASTES

Canning-factory wastes, including the husks, shanks, silks, and cobs of sweet corn, were formerly considered worthless and were left in piles to decompose or were hauled away to a dumping ground at considerable expense. On the basis that from 600 to 900 pounds of canned corn is obtained from 1 ton of sweet corn as delivered, the canning concern must consider the disposal of wastes amounting to from 55 to 70 percent of the original material. These wastes are now considered a valuable byproduct, but in some regions this material is being neglected because its feeding or manurial value is not fully appreciated.

SWEET CORN WASTE AS SILAGE

Many of the larger factories are equipped with a silo or a battery of silos in which to conserve the sweet corn wastes (fig. 1). Sometimes only the husks are made into silage, and since they may ferment too rapidly the action is often retarded by mixing some drier material, such as oat straw or dry fodder from the field, with the greener material. The cobs have sometimes proved unsatisfactory when used whole. A part of the failure in making sweet corn silage is probably due to the fact that whole cobs from the factory do not pack tightly into the silo. The presence of air in unpacked silage prevents the proper preservation of the material. Some operators run the cobs through silage cutters or shredders so that the mass will pack to better advantage. Silos for the individual grower are common in dairy and livestock-feeding sections, and frequently a part of these factory wastes is obtained by agreement and ensiled on the farm.

Some canning firms pile their corn wastes in large stacks, covering the accumulation of pea vines and other material obtained earlier in the season. These stacks may be of any size or shape, and are frequently 80 feet long, 20 feet wide, and as high as it is convenient to make them. Care is taken in forming these stacks by maintaining a steep pitch to the sides and thoroughly trampling the mass to exclude the air and to insure proper fermentation. A ditch is usually made

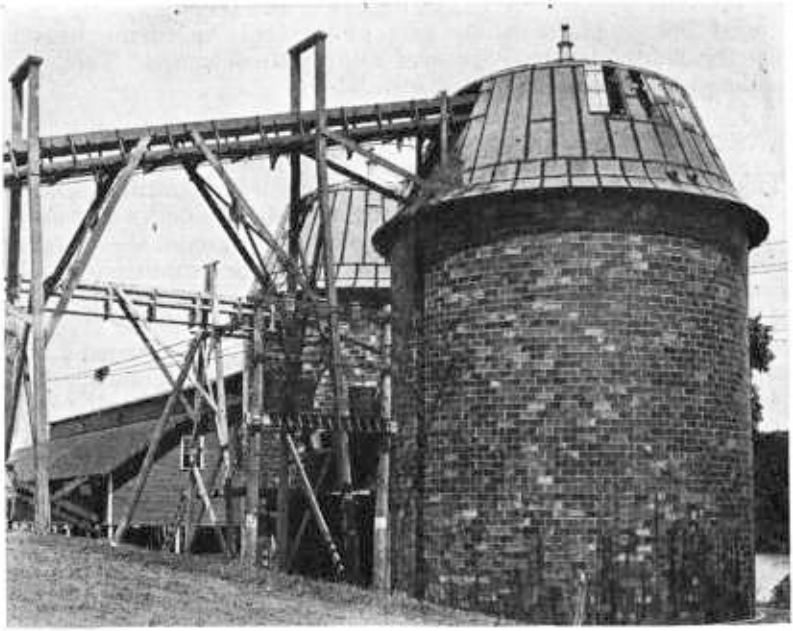

FIGURE 1.—Silos used for preserving the husks and other waste from sweet corn.

around the edges of the refuse piles to carry away the liquid seepage that oozes from them. This liquid should not be placed on farming land, for it has an injurious effect on the crops because of its souring, fermentative action.

Most contracts contain a statement providing that the corn husks and cobs are to belong to the factory. The canner may allot a reasonable quantity for immediate feeding during the canning season or may reserve the fresh and ensiled material for his own feeding operations, or he may distribute the cobs, retaining only the husks. Often the factory sells the silage to the growers and, in case of surplus, to other feeders of livestock.

FACTORY WASTES AS MANURE

The factory wastes have some fertilizing value as manure. Husks, especially the completely decomposed outer layers of the stack, have been used as orchard mulch. Although the practice is not always advisable, cobs have been spread on heavy clay spots in fields in layers about 6 inches deep. During the first year after plowing under, the results proved discouraging because of the slowness of decomposition, but after a second season the land became friable and mellow, bringing the soil nearer to desirable cultural conditions. The husks decompose more rapidly than the cobs, but they are seldom used because of their greater value as silage. It is perhaps better if this roughage is first fed to stock, as only part of the fertilizing constituents need be lost in animal feeding. Then if the manure is given protection from weathering and losses from seepage, a double value will be obtained, first from the palatable fodder and later in the use of the manure.

DISEASES [2]

Root rots cause great losses in sweet corn, especially in the field corn regions. Infection of a crop may occur from diseased seed or from soil that contains the organisms. In either case the corn crop gives reduced yields, irregular growth and maturity, barren stalks or stalks bearing nubbin ears, and plants that die prematurely. Experimental work shows that the infection of seed may be considerable and that it pays to test all seed stock and to discard that seriously infected. The grower should select disease-free ears. If there is any question as to freedom from disease, the seed should be treated with one of the organic mercury dusts recommended for seed treatment in Miscellaneous Publication 219, Treat Seed Grain. The rotation of crops and the maintenance of a highly fertile condition of the soil will keep down to some extent the amount of damage if the soil becomes infested.

Smut is a widely distributed disease, attacking the stalks, ears, and tassels of the sweet corn plant. The organism produces irregular galls or outgrowths, covered at first with a white membrane, but later breaking open and scattering masses of spores. The smut fungus will infect at any actively growing point or fresh wound on the plant at any period during the growth of the crop. In valuable plots the amount of damage can be reduced by cutting away and burning all smutted parts before the smut galls are mature. Treatment of the seed to prevent smut is of no avail. Rotation of crops should be practiced, and land should not be top-dressed with manure or refuse matter produced from the feeding of smut-infected corn stover to livestock. The ensiling of corn is said to destroy the smut spores.

Ear rots are caused by several fungi and produce imperfectly developed ears which are soft and often covered with a mold. The ear rots are of importance chiefly where sweet corn is grown for seed. The trouble is more serious in moist, warm weather. Control measures include the practice of a rotation, clean cultivation, and the use of disease-free seed or seed of disease-resistant strains.

Bacterial wilt, or Stewart's disease, of sweet corn occurs every year in the Middle Atlantic States, where only resistant varieties can be grown to advantage. In most years the disease is unimportant in other sweet corn growing areas. After a series of mild winters the disease occasionally causes serious losses throughout the Corn Belt and may spread into the Northern States and Canada. The bacteria live over winter in one of the corn flea beetles and are carried to the young corn plants upon which the beetles feed. Throughout the season the beetles spread the disease by carrying the bacteria from diseased to healthy plants. Long, light-yellow streaks develop in the leaves, bacteria fill the vessels, or water-conducting fibers, of the stalk and ooze out as yellow beads from the cut ends. Plants may wilt and die or remain stunted, develop premature tassels, and bear nubbins or no ears at all. Golden Bantam and other early varieties are most susceptible. Late-maturing varieties are resistant. Resistant hybrids and strains, such as Golden Cross Bantam, Marcross, Whipcross, Spancross, and Ioana, developed recently in cooperative studies by the United States Department of Agriculture and the experiment

[2] Prepared by A. G. Johnson, principal pathologist, and Charlotte Elliott, pathologist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering.

stations, by the stations themselves, and by other agencies, offer a certain degree of control.

A leaf blight caused by the fungus *Helminthosporium turcicum* is sometimes severe on sweet corn, but usually it occurs too late in the season to affect the crop for canning. The fungus is not seed-borne but is carried by the wind from infected crop residues. No resistant varieties are known.

For detailed information concerning these or other diseases, communicate with your State agricultural experiment station or with the Plant Industry Station, Beltsville, Md.

INSECTS [3]

Many species of insects are known to be injurious to Indian corn, and practically all of these attack sweet corn. Some of these cause damage such as to reduce materially the yield and quality of the product. Among the more important insect pests of this group are the following: Corn earworm, European corn borer, common cornstalk borers, webworms, armyworm, army cutworm, fall armyworm, chinch bug, green bug, corn leaf aphid, corn root aphid, white grubs, leafhoppers, grasshoppers, wireworms, seed-corn maggot, and southern corn rootworms.

The control of these pests in sweet corn for the most part is similar to the control of such insects in field corn. However, the control measures differ somewhat because of the variation in cultural practices and more particularly in the value of the crop per acre. Information is usually available on the biology and control of most of these insects, and although the damage caused by various species may look the same, the control measures are usually different for the various species in the same locality and even the same species in different parts of the country.

When injury is observed and information is desired, specimens of the insect causing the damage and a sample of the injured plant should be sent either to the State agricultural experiment station or to the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington 25, D. C.

[3] Prepared by W. H. Larrimer, formerly principal entomologist, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration.

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